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Radioactivity in water from uranium mining regions

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Uranium mining and milling is known to produce enhancement of environmental radioactivity. In particular through surface runoff, waste water discharges, acid mine drainage, and seepage, radioactivity levels may increase in the surrounding areas and contaminate groundwater and surface waters. Results from radioactivity surveys in the center north of Portugal to assess the impact of past uranium mining activities showed that uranium series radionuclides in water may vary in a wide range. For example, in drainage from milling tailings at Urgeiriça, dissolved uranium (^{238}U), radium (^{226}Ra) and polonium (^{210}Po) were 35700 ± 1100 , 1084 ± 30 , and 700 ± 40 mBq/L, respectively. In the river Dão in the region, concentrations of the same radionuclides were 8.0 ± 0.3 , 5.9 ± 0.8 and 9.7 ± 0.4 mBq/L, respectively, at background level and thus much lower. Water from open pits of flooded old uranium mines were often also high, such as in Mortórios mine, with 19890 ± 520 , 34.8 ± 3.5 and 5.8 ± 0.2 mBq/L for the same radionuclides. In water from contaminated irrigation wells near the Cunha Baixa mine, concentrations were 4152 ± 122 , 732 ± 53 , and 5.1 ± 0.2 mBq/L. These water bodies and irrigation wells were found contaminated beyond reasonable level for water use, and water treatment and remedial measures were applied, including supply of alternate water. However, in such a uranium bearing granite regions of Portugal, concentration of radionuclides in water bodies outside the influence of old uranium mines were determined sometimes at high levels as well. For example, the water from a bore hole in a farm near Espinho village displayed 999 ± 29 , 819 ± 42 , and 2782 ± 150 mBq/L, respectively for ^{238}U , ^{226}Ra , and ^{210}Po . Water from another bore hole in Reboleiro area displayed concentrations of 4205 ± 184 , 29.9 ± 1.3 , and 33.0 ± 1.6 mBq/L, respectively for the same radionuclides. These naturally radioactive waters, sometimes with alpha emitting radionuclide concentrations higher than in uranium drainage from old mines, likely result from water contact with uranium mineralizations, sometimes under oxic other times under anoxic conditions. This calls the attention to the need for systematic radioactivity screening of water supplies in granite and uranium bearing areas. Proper water management and radiation protection in such regions should encompass waste waters and mine waters, but also natural waters.

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